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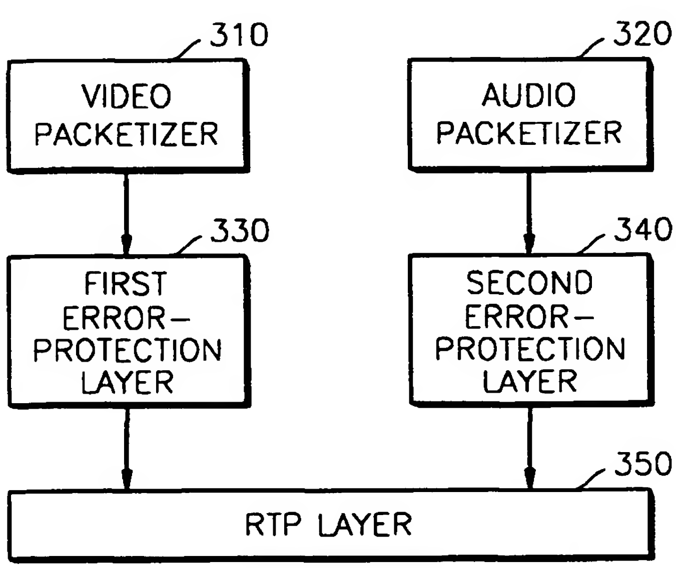
(54) Title: METHOD AND APPARATUS FOR TRANSMITTING AND RECEIVING MULTIMEDIA DATA



(57) Abstract: An apparatus for transmitting/receiving multimedia data including video data via a wireless packet in a radio transmitting/receiving system, and a method thereof are provided. The method comprises the step of performing uneven error-protection with respect to one source packet or a plurality of source packets. According to the present invention, error resilience of multimedia data (especially that of video data) can be increased by unevenly error-protecting with respect to the source packets without changing the stack of transmission/reception protocol in a conventional packet network such as H. 323.

WO 01/74012 A1

METHOD AND APPARATUS FOR TRANSMITTING AND RECEIVING MULTIMEDIA DATA

Technical Field

The present invention relates to a radio transmitting/receiving system, and more particularly, to an apparatus for transmitting/receiving multimedia data including video data via a wireless packet in a radio transmitting/receiving system, and a method thereof.

Background Art

In general, the H.323 protocol is the preferred protocol of the International Telecommunications Union, Telecommunications Sector (ITU-T) for video conferencing in a communications environment in which a quality of service (QoS) is not guaranteed, such as the Internet-based transmission control protocol/ Internet protocol (TCP/IP) and the user datagram protocol (UDP).

Referring to FIG. 1, a video packetizer 110 and an audio packetizer 120 perform source-encoding and create packets of video data and audio data. A real-time transmission protocol (RTP) layer 130 inserts a time stamp in the packets of the video data and the audio data and creates a RTP packet by combining the video data packet with the audio data packet, which are created in the video packetizer 110 and the audio packetizer 120, respectively. The RTP layer 130 provides functions such as identification of data type, checking of sequence numbers, transmission of internal time stamps, and monitoring of data transmission. Here, the header of the RTP layer 130, as shown in FIG. 2, includes a miscellaneous (MISC) field, a sequence number field, a time stamp field, a synchronization source (SSRC) identifier, and a contributing source (CSRC) identifier. Here, the MISC field is a 16-bit field including version, padding, extension, CSRC count, marker, and payload type information. A user datagram protocol (UDP) layer 160 mixes the RTP packet created in the RTP layer 130 with a H.225 control signal generated from a H.225 control unit 140. A

transmission control protocol (TCP) layer 170 creates a TCP packet to be re-transmitted, by using the H.225 control signal generated from the H.225 control unit 140 and a H.245 media control signal generated from a H.245 control unit 150. An Internet protocol (IP) layer 180 creates an IP packet by using a UDP packet created in the UDP layer 160 and a TCP packet created in the TCP layer 170.

However, in the H.323 shown in FIG. 1, there are no error-resilient layers between a source packetizer formed of the video packetizer 110 and the audio packetizer 120, and the RTP layer 130, and the header has the structure shown in FIG. 2 in the RTP layer 130.

As a result, when there is no error-protection capability, which is robust to the source packetizer (or source codec layer), packet loss can occur in an error-prone environment such as a wireless environment.

A conventional forward error correction (FEC) scheme such as convolution coding and bose-chaudhuri-hocquenghem (BCH) is implemented only in a physical layer, and due to the complexity, it is difficult for the FEC scheme to be implemented in the layers before the RTP layer.

Disclosure of the Invention

To solve the above problems, it is an object of the present invention to provide a method for transmitting and receiving multimedia data in which error resilience can be improved by unevenly error-protecting with respect to source packets.

It is another object of the present invention to provide an apparatus for transmitting and receiving multimedia data in which the method for transmitting and receiving multimedia data is implemented.

Accordingly, to achieve the object, according to one aspect of the present invention, there is provided a method for transmitting multimedia data in multimedia data transmitting and receiving system in a wireless packet network. The method comprises the steps of: (a) packetizing source data; and (b) performing uneven error-protection with respect to one source packet or a plurality of source packets packetized in the step (a).

Preferably, redundancy information is added to all of one packet or a plurality of source packets in the step (b).

Preferably, redundancy information is added to a portion of one packet or a plurality of source packets in the step (b).

Preferably, redundancy information is added to one portion or a plurality of portions of one source packet or a plurality of source packets in the step (b).

In order to achieve the object, according to another aspect of the present invention, there is provided a method for transmitting multimedia data in multimedia data transmitting or/and receiving system in a wireless packet network. The method comprises the steps of: (a) packetizing source data; and (b) forming a RTP packet of payload, which is unevenly error-protected with respect to one source packet or a plurality of source packets packetized in the step (a), and an arbitrary RTP header.

In order to achieve the object, according to still another aspect of the present invention, there is provided a method for receiving multimedia data in a multimedia data receiving system for receiving a RTP packet to which an error protection packet, which is unevenly error-protected with respect to one source packet or a plurality of source packets, is added. The method comprises the steps of: (a) receiving a RTP packet through predetermined transmission protocol in the wireless packet network and checking the number of the received RTP packet; (b) referring to a payload type in the header of the RTP packet received in the step (a) and detecting the number of the RTP packet used for error-protection coding when the RTP packet corresponds to the error-protection packet; (c) detecting the number of a lost packet by comparing the number of the RTP packet checked in the step (a) with the number of the RTP packet detected in the step (b); and (d) recovering a non-received RTP packet by referring to the number of the lost packet detected in the step (c).

In order to achieve another object, according to one aspect of the present invention, there is provided an apparatus for transmitting multimedia data in multimedia data transmitting or/and receiving system in

a wireless packet network. The apparatus includes a source packetizer unit for packetizing multimedia data, a RTP layer unit for inserting a time stamp in the packets of a multimedia data and for creating real-time transmission protocol (RTP) packet by combining the packets of the multimedia data created in the source packetizer unit, and a error-protection unit for adding uneven redundancy information to one multimedia packet or a plurality of multimedia packets, which is or are packetized between the source packetizer unit and the RTP layer unit or in the RTP layer unit.

In order to achieve another object, according to another object of the present invention, there is provided an apparatus for receiving multimedia data in multimedia data receiving system for receiving a RTP packet to which redundancy information for unevenly error-protecting one source packet or a plurality of source packets, is added. The apparatus includes a means for receiving a multimedia RTP packet through a predetermined transmission protocol in the wireless packet network, and a means for correcting a bit error occurred in a channel on the basis of redundancy information, which is unevenly added to the received multimedia RTP packet.

Brief Description of the Drawings

FIG. 1 is a detailed block diagram of the H.323 protocol;

FIG. 2 is a block diagram of the header of real-time transport protocol (RTP) of FIG. 1;

FIG. 3 illustrates the structure of protocol for transmitting multimedia data according to the present invention;

FIG. 4 is a flow chart illustrating a method for transmitting multimedia data according to the present invention;

FIGS. 5A through 5C illustrate the embodiments of an uneven error-protection method according to the present invention;

FIGS. 6A through 6D are format diagrams of a forward error correction (FEC) packet of FIGS. 5A through 5C;

FIG. 7 is a flow chart illustrating a method for receiving multimedia

data according to the present invention; and

FIG. 8 illustrates a communications system in which the method for receiving multimedia data according to the present invention is implemented.

Best mode for carrying out the Invention

Referring to FIG. 3, the protocol for transmitting new multimedia data inserts a first error-protection layer 330 and a second error-protection layer 340, respectively, between a source packetizer including a conventional video packetizer 310 and an audio packetizer 320, and a real-time transmission protocol (RTP) layer 350.

The first error-protection layer 330 and the second error-protection layer 340 create a forward error correction (FEC) packet, the result of performing uneven error-protection with respect to one video or audio packetizer or a plurality of video or audio packetizer, which is or are packetized in the video packetizer 310 and the audio packetizer 320.

Referring to FIG. 4, first, the video packetizer 310 and the audio packetizer 320 creates video data packets and audio data packets, respectively (step 410).

Next, the first and second error-protection layers 330 and 340 perform uneven error-protection with respect to the created video data packets and audio data packets (step 420). That is, an uneven error-protected FEC packet is added to a number (N) of video data packets and audio data packets.

Next, the RTP layer 350 inserts a time stamp in each packet and creates one RTP packet by combining the video data packets and the audio data packets (step 430).

In another preferred embodiment, protocol for transmitting new multimedia data can add the FEC packet, which is unevenly error-protected with respect to the source packets, to the upper layer of the RTP layer, and in the RTP layer, the RTP packet can be formed of payload to which the FEC packet, which is unevenly error-protected with respect to an arbitrary

RTP header and the source packets, is added.

Referring to FIG. 5A, when a number (N) of video and audio data packets (packet 1, packet 2, packet 3, and packet 4) are combined with one another and created as a RTP packet, a FEC packet, which corresponds to the redundancy of a length L, is added to the RTP packet for error-protection with respect to all of the packets (packet 1, packet 2, packet 3, and packet 4).

Here, N and L are system-dependent, and the redundancy may be bit-by-bit exclusive OR (XOR) and a Reed-Solomon code corresponding to error-checking or error-protection.

Referring to FIG. 5B, when a number (N) of video and audio data packets (packet 1, packet 2, packet 3, and packet 4) are combined with one another and created as a RTP packet, a FEC packet, which corresponds to the redundancy of a length L, is added to the RTP packet with respect to an important portion, for example, header information, instead of error-protection with respect to all of the packets (packet 1, packet 2, packet 3, and packet 4).

Referring to FIG. 5C, when a number (N) (N1 + N2) of video and audio data packets (packet 1, packet 2, packet 3, and packet 4) are combined with one another and created as a RTP packet, a FEC packet 1 and a FEC packet 2, which correspond to the redundancy of lengths L1 and L2, are added to the RTP packet with respect to divisible portions by one packet (packet 1, packet 2, packet 3, and packet 4) or a plurality of packets N1 and N2. Here, N1, N2, L1, and L2 are system-dependent. Also, the divisible portions may be the groups of header information and a motion vector when data partitioning is used in MPEG-4 video and H.263.

In still another preferred embodiment, when a number (N) of video and audio data packets (packet 1, packet 2, packet 3, and packet 4) are combined with one another and created as a RTP packet, redundancy information can be differently added to the RTP packet with respect to syntaxes having different importance of one source packet or a plurality of source packets.

When the created RTP packet is decoded, a recipient can correct a bit error occurring in a channel on the basis of redundancy information, which is unevenly added to a multimedia RTP packet, which is received a through predetermined protocol.

Referring to FIG. 6A, a FEC packet includes a RTP header, a FEC header, a first uneven level protection (ULP) layer header **ULP layer 1 header**, a first ULP layer payload **ULP layer 1 payload**, a second ULP layer header **ULP layer 2 header**, and a second ULP layer payload **ULP layer 2 payload**. FIG. 6B is a format diagram of the FEC header of FIG. 6A. A payload type (PT) for identifying a FEC packet and a sequence number SN corresponding to the number of the RTP packet are stored in the RTP header. The first and second ULP layers include protection level information and payload on lengths L1 and L2 of the FEC packet.

The FEC header of FIG. 6B has a total of 12 bytes and includes a sequence number base field (SN base) corresponding to the sequence number of a first RTP packet used in the FEC packet, a length recovery field (Length recovery), an extension field (E), a payload type recovery field (PT recovery), a mask field for indicating the packet used in the FEC packet (mask), and a time stamp recovery field (TS recovery).

Referring to FIG. 6C, the first ULP layer header **ULP layer 1 header** includes a 16-bit protection length field.

Referring to FIG. 6D, the second ULP layer header **ULP layer 2 header** includes a total of 16-bit protection length field and a 24-bit mask field.

Referring to FIG. 7, a receiver receives a RTP packet and transmits the RTP packet to an upper layer and stores the contents of the same RTP packet in a buffer. Also, the receiver stores the received RTP packet in the buffer before receiving a FEC packet.

First, the RTP packet is received, and the sequence number of the received RTP packet is checked (step 710). Here, the sequence number of received RTP packets is recorded in a separate memory location.

Next, it is determined whether the RTP packet is the FEC packet by

referring to the payload type (PT) in the header of the received RTP packet (step 720).

Next, when the RTP packet is the FEC packet in the step 720, the RTP sequence number used in the FEC packet is detected by referring to the SN base field and the mask field of the FEC header (step 730). In a case where the FEC packet is formed of more than two ULP layers, the RTP sequence number used in the corresponding ULP layers is detected by referring to the mask field contained in the header of each of the ULP layers (step 730).

Next, the sequence number corresponding to a lost RTP packet is detected by comparing the RTP sequence number recorded in the separate memory with the RTP sequence number used in the FEC packet (step 740). For example, when the RTP sequence numbers recorded in the memory are 1, 2, 4, and the RTP sequence numbers used in the FEC packet are 1,2,3, and 4, the lost RTP sequence number is 3.

Next, a third RTP packet that has not been received is recovered by referring to the lost RTP sequence number (step 750). That is, the RTP packet that has not been received is recovered by the first ULP layer payload and the received RTP packet. In a case where there are more than two ULP headers in the FEC packet, the RTP packet that has not been received is recovered by referring to each of the ULP layer payloads. Also, the RTP packet that has not been received is XOR or RS decoded by using an XOR or RS decoded FEC packet and the RTP packet used in the FEC packet.

The steps are repeated until the reception of the RTP packet is completed (step 760).

Referring to FIG. 8, in order to provide the RTP packet, point-to-point connection having one channel between a client C and a server S or multicasting connection having a plurality of channels between the client C and the server S are provided. That is, the server S employing the point-to-point connection transmits the RTP packet and the FEC packet to the client C. Here, when the client C does not have the function of receiving the FEC

packet, the FEC packet is discarded. The server S employing the multicasting connection transmits the RTP packet and FEC packet, respectively, via separate channels to the client C.

The above encoding and decoding methods can be embodied in a computer program. Codes and code segments encompassing the program can be easily inferred to by a skilled computer programmer in the art. Also, the program can be realized in media used in a computer and in a common digital computer for operating the program. The program can be stored in computer readable media. The media can include magnetic media such as a floppy disk or a hard disk and optical media such as a CD-ROM or a digital video disc(DVD). Also, the program can be transmitted by carrier waves such as the Internet.

While this invention has been particularly shown and described with reference to preferred embodiments thereof, it will be understood by those skilled in the art that various changes in form and details may be made therein without departing from the spirit and scope of the invention as defined by the appended claims.

Industrial Applicability

As described above, error resilience of multimedia data (especially that of video data) can be increased by unevenly error-protecting with respect to the source packets without changing the stack of transmission/reception protocol in a conventional packet network such as H. 323.

What is claimed is:

1. A method for transmitting multimedia data in multimedia data transmitting or/and receiving system in a wireless packet network, comprising the steps of:

(a) packetizing source data; and

(b) performing uneven error-protection with respect to one source packet or a plurality of source packets packetized in the step (a).

2. The method according to claim 1, wherein the step (a) is performed in a layer before reaching a real-time transmission protocol (RTP) layer.

3. A method for transmitting multimedia data in a multimedia data transmitting and receiving system in a wireless packet network, comprising the steps of:

(a) packetizing source data; and

(b) forming a RTP packet of payload, which is unevenly error-protected with respect to one source packet or a plurality of source packets packetized in the step (a), and an arbitrary RTP header.

4. The method according to claims 1 or 3, wherein redundancy information is added to all of one packet or a plurality of source packets in the step (b).

5. The method according to claims 1 or 3, wherein redundancy information is added to a portion of one packet or a plurality of source packets in the step (b).

6. The method according to claim 5, wherein the portion of the source packets is header information of each packet.

7. The method according to claims 1 or 3, wherein redundancy

information is differently added to syntaxes having different importance of one source packet or a plurality of source packets in the step (b).

8. The method according to claims 1 or 3, wherein redundancy information is added to one portion or a plurality of portions of one source packet or a plurality of source packets in the step (b).

9. The method according to one of claims 4 through 8, wherein the redundancy information is a forward error correction (FEC).

10. The method according to claim 9, wherein the FEC is one of an exclusive OR (XOR) or a Reed-Solomon code.

11. An apparatus for transmitting multimedia data in multimedia data transmitting or/and receiving system in a wireless packet network, comprising:

a source packetizer unit for packetizing multimedia data;

a RTP layer unit for inserting a time stamp in the packets of a multimedia data and for creating real-time transmission protocol (RTP) packet by combining the packets of the multimedia data created in the source packetizer unit; and

a error-protection unit for adding uneven redundancy information to one multimedia packet or a plurality of multimedia packets, which is or are packetized between the source packetizer unit and the RTP layer unit or in the RTP layer unit.

12. An apparatus for receiving multimedia data in multimedia data receiving system for receiving a RTP packet to which redundancy information for unevenly error-protecting one source packet or a plurality of source packets, is added, comprising:

a means for receiving a multimedia RTP packet through a predetermined transmission protocol in the wireless packet network; and

a means for correcting a bit error occurring in a channel on the basis of redundancy information, which is unevenly added to the received multimedia RTP packet.

13. A method for receiving multimedia data in multimedia data receiving system for receiving a RTP packet to which an error protection packet, which is unevenly error-protected with respect to one source packet or a plurality of source packets, is added, comprising the steps of:

(a) receiving a RTP packet through a predetermined transmission protocol in the wireless packet network and checking the number of the received RTP packet;

(b) referring to a payload type in the header of the RTP packet received in the step (a) and detecting the number of the RTP packet used for error-protection coding when the RTP packet corresponds to the error-protection packet;

(c) determining the number of a lost packet by comparing the number of the RTP packet checked in the step (a) with the number of the RTP packet detected in the step (b); and

(d) recovering a RTP packet that has not been received by referring to the number of the lost packet detected in the step (c).

14. The method according to claim 13, wherein the number of the RTP packet used for error-protection coding in the step (b) is detected by referring to a sequence number field and a mask field, which are arranged in the header of the error-protection packet.

15. The method according to claim 13, wherein the RTP packet that has not been received in the step (d) is recovered by payload on a protection level layer arranged in the error-protection packet and the received RTP packet in the step (a).

16. The method according to claim 13, wherein the RTP packet

that has not been received in the step (d) is recovered by referring to each payload in a case where there is a header on more than two protection level layers in the error-protection packet.

17. The method according to one of claims 15 or 16, wherein the RTP packet that has not been received in the step (d) is received by one of XOR or RS decoding.

FIG. 1

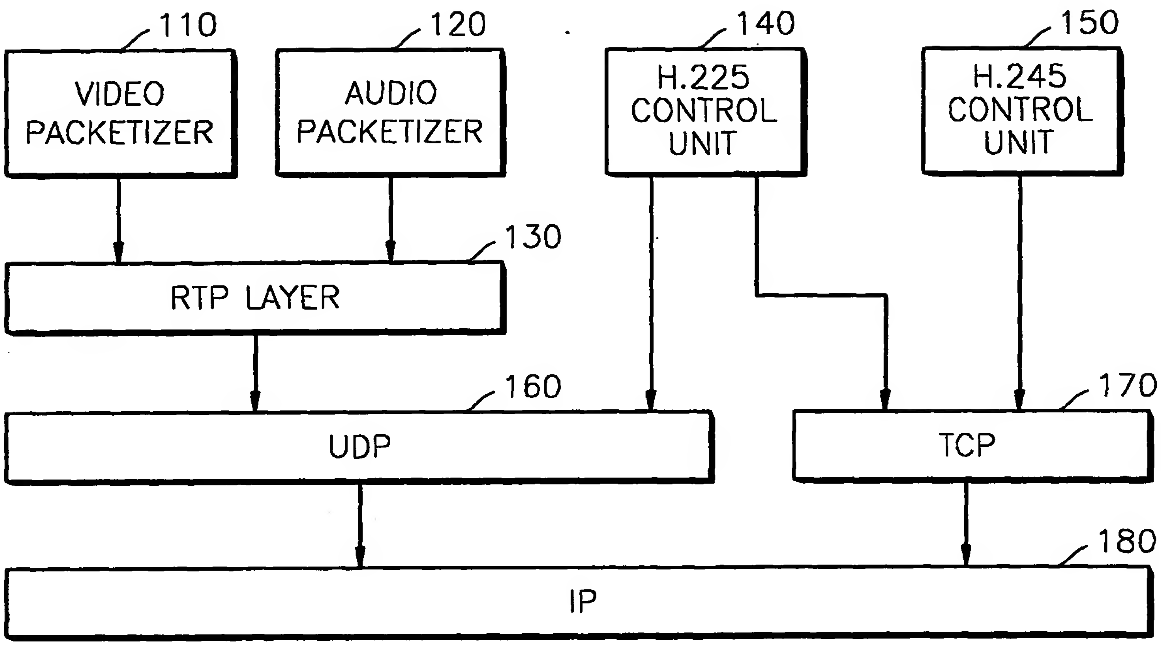

110
VIDEO PACKETIZER
120
AUDIO PACKETIZER
140
H.225 CONTROL UNIT
150
H.245 CONTROL UNIT
130
RTP LAYER
160
UDP
170
TCP
180
IP

FIG. 2

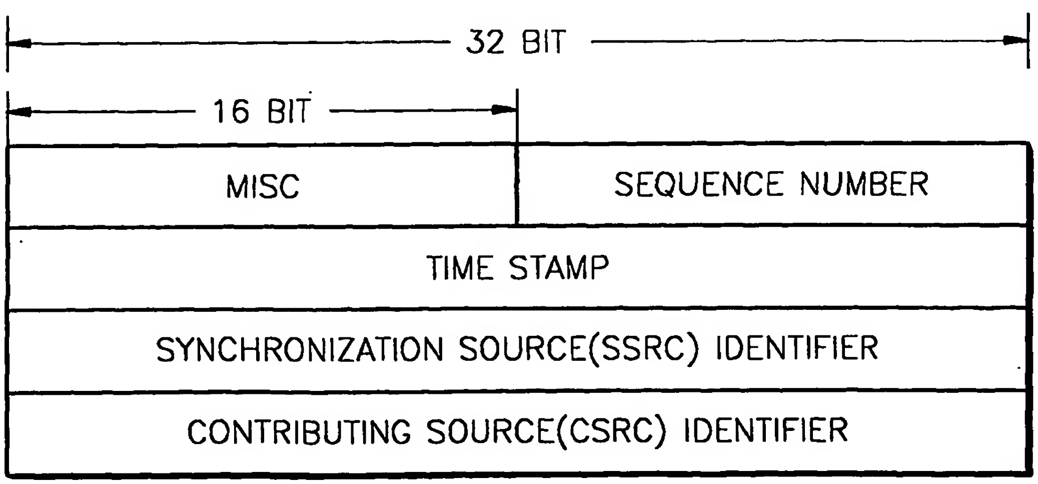

32 BIT
16 BIT
MISC
SEQUENCE NUMBER
TIME STAMP
SYNCHRONIZATION SOURCE(SSRC) IDENTIFIER
CONTRIBUTING SOURCE(CSRC) IDENTIFIER

FIG. 3

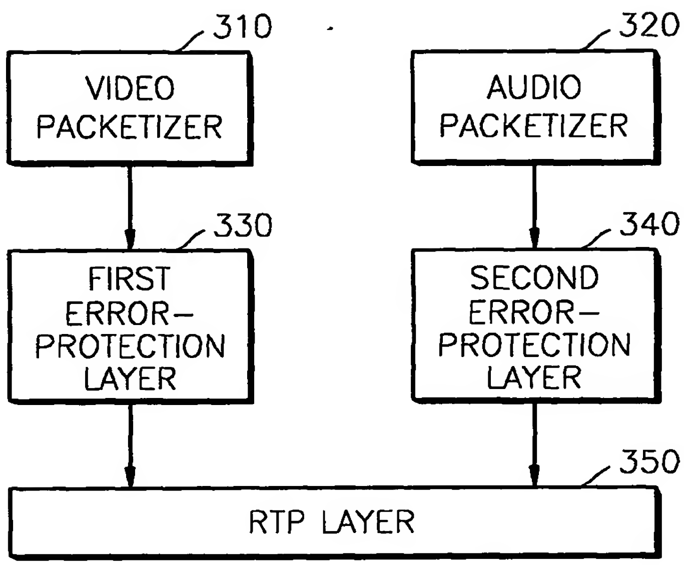

310
VIDEO PACKETIZER
320
AUDIO PACKETIZER
330
FIRST ERROR-PROTECTION LAYER
340
SECOND ERROR-PROTECTION LAYER
350
RTP LAYER

FIG. 4

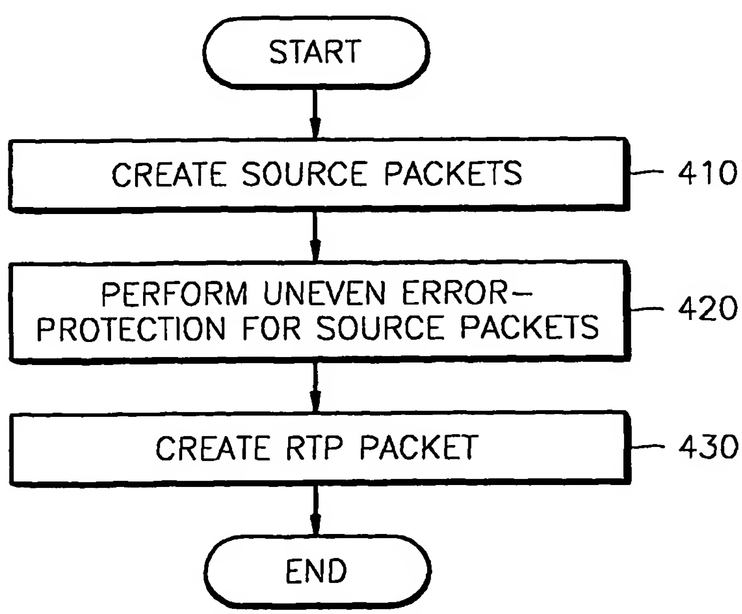

START
CREATE SOURCE PACKETS
410
PERFORM UNEVEN ERROR-PROTECTION FOR SOURCE PACKETS
420
CREATE RTP PACKET
430
END

FIG. 5A

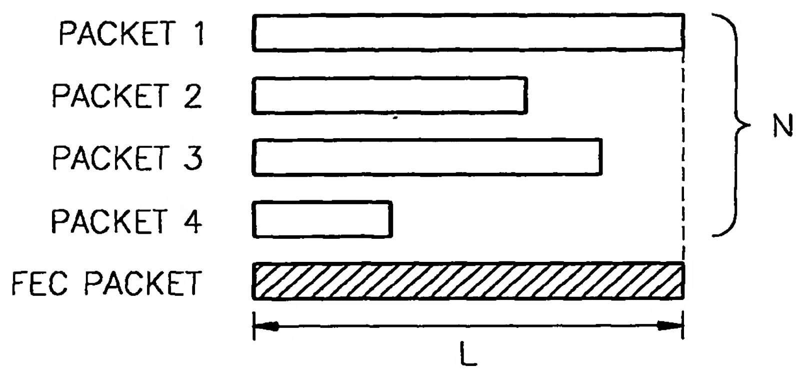


FIG. 5B

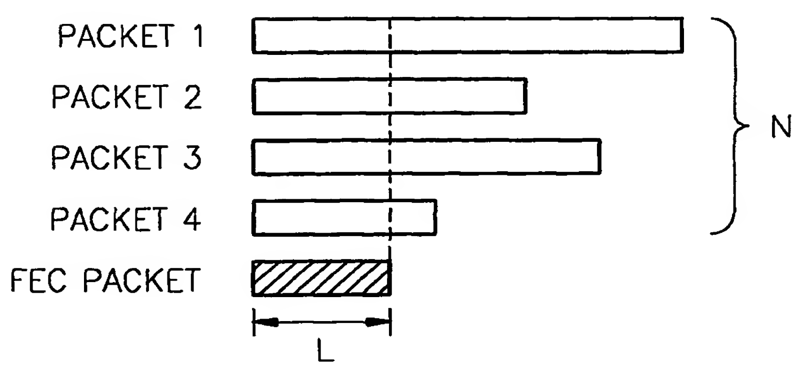


FIG. 5C

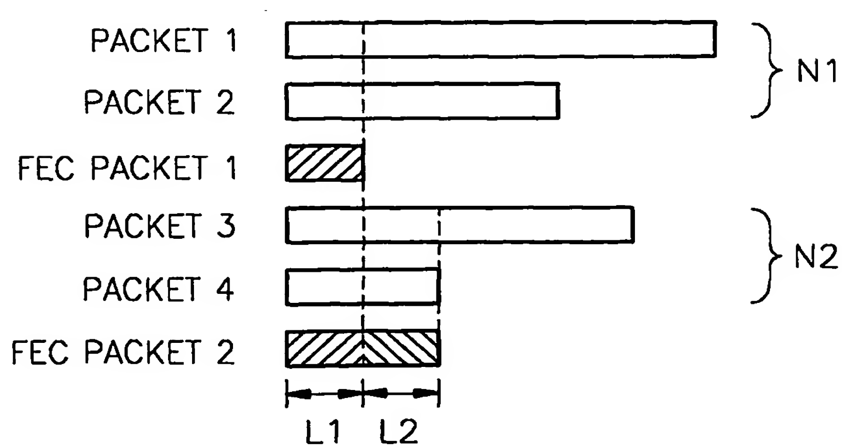


FIG. 6A

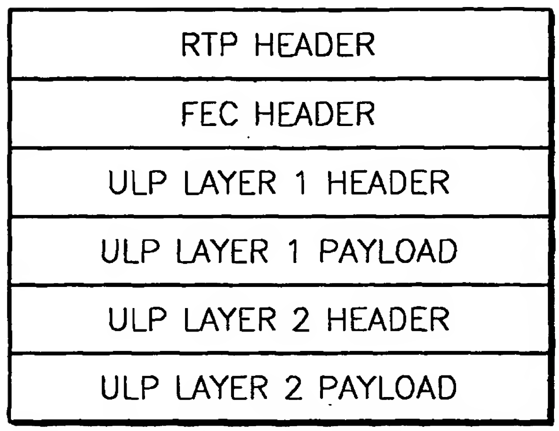


FIG. 6B

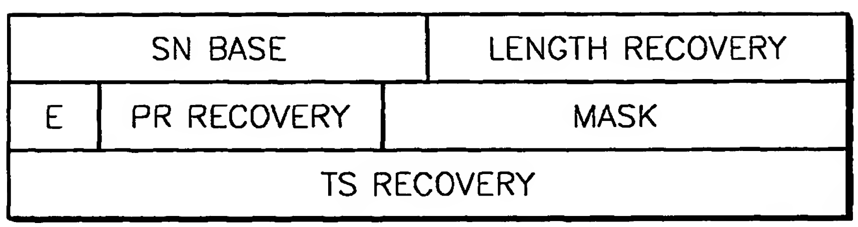


FIG. 6C

FIG. 6D

FIG. 7

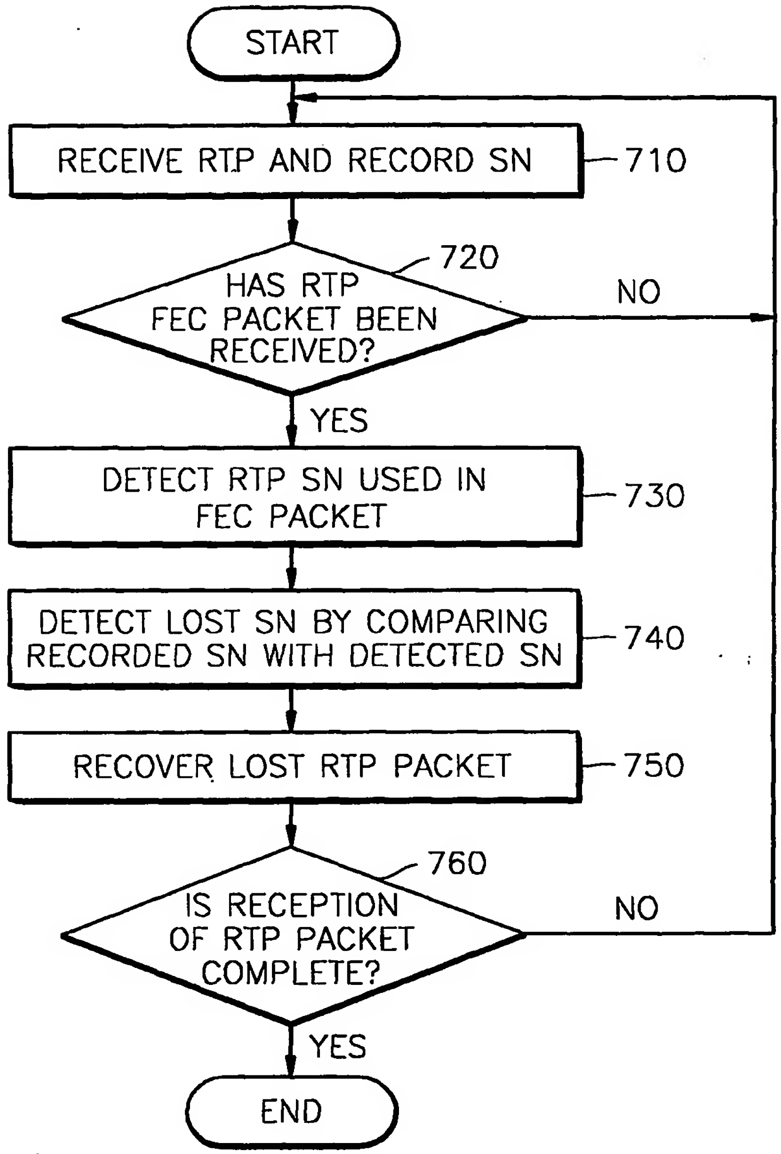
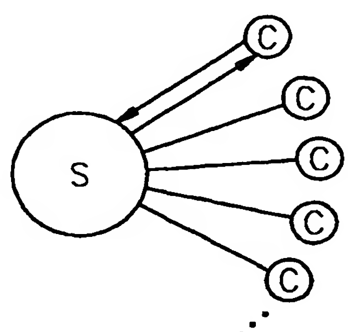

START
RECEIVE RTP AND RECORD SN
710
720
HAS RTP FEC PACKET BEEN RECEIVED?
NO
YES
DETECT RTP SN USED IN FEC PACKET
730
DETECT LOST SN BY COMPARING RECORDED SN WITH DETECTED SN
740
RECOVER LOST RTP PACKET
750
760
IS RECEPTION OF RTP PACKET COMPLETE?
NO
YES
END

FIG. 8


S
C
C
C
C
C

INTERNATIONAL SEARCH REPORT

International application No.
PCT/KR00/01571

A. CLASSIFICATION OF SUBJECT MATTER

IPC7 H04L 12/28

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimun documentation searched (classification system followed by classification symbols)

IPC7: H04L, H04M, G06F

Documentation searched other than minimun documentation to the extent that such documents are included in the fileds searched

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Korean Utility Models and Applications for Utility Models since 1975

Electronic data base consulted during the intertnational search (name of data base and, where practicable, search trerms used)

IEL

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	JP 1999-088462 : abstract, discription and figures claim 2-3	13-17
A	Vehicular Technology Conference, 1999. VTC '99-Fall, IEEE VTC 50th, 19-22 Sep. 1999 pp.879-883 , Vol.2, Guerri,J.C et al. "A feedback packet-level error control for real time applications in wireless networks"	12-17
A	Computers and Comㄴ, 1999.Proceedings IEEE International Symposiums on. 6-8 July. 1999 pp.324-330 ,Meggers J.;Subramaniam, R. "A new feedback error control scheme forblock based video communication in packet switched wireless networks"	7-10
A	Multimedia Computing and Systems, 1999,. IEEE International Conference on, 7-11 June. 1999 pp.333-337 , Vol.2, Guerri,J.C et al. "Dynamic frequencyand resource allocation with adaptive error control based on RTP for multi-media QoS guarantees in wireless networks"	7-10

☐ Further documents are listed in the continuation of Box C. ☒ See patent family annex.

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Patent document cited in search report	Publication date	Patent family member(s)	Publication date
JP 1999-088462:	03. 30. 1999	None	